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10/848,985	05/18/2004	Eugene P. Marsh	2002-0717.01/US	5986

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MICRON TECHNOLOGY, INC.
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BOISE, ID 83707-0006

EXAMINER

TSAL, H JEY

ART UNIT	PAPER NUMBER
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2812

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/31/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/848,985

Applicant(s)

MARSH ET AL.

Examiner

H.Jey Tsai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 November 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7 and 9-35 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 9-16, 18-20, 22-24 and 26-35 is/are rejected.
- 7) ☒ Claim(s) 17, 21 and 25 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 27, 29, 31 stand rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. "exposure of the oxide layer to the silicon containing gas does not result in the formation of another layer over the oxide layer" is not described in the specification.

Claims 1-7, 9-35 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. "without substantially prior exposure of the oxide layer to oxygen" is not described in the specification.

Claims 32-35 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter

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which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. "without prior exposure of the oxide layer to a dopant" is not described in the specification.

Claims 1-7, 9-18, 20-21, 26, 29-32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. "a compound consisting essentially of silicon containing gas selected from the group consisting of SiH_4 , Si_2H_6 and methylated silanes" is not described in the specification.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 1 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Sashida et al. 2001/0012659.

Sashida et al. discloses a method of adhering a ruthenium metal layer to an oxide layer of a semiconductor, the method comprising:

exposing the oxide layer 6 to a silane comprising essentially of silane, para. 72, and fig. 5B,

after exposing the oxide layer 6 to the silicon containing gas,

forming the ruthenium metal layer 17 to contact the oxide layer 6, para. 58.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii et al. 6,053,791 in view of Terbrueggen et al. 2004/0053290 and Yoshida et al. 2003/0164469, newly cited.

The reference(s) teach the features :

Fujii et al. discloses a method of forming a ruthenium layer to an oxide layer of a semiconductor, the method comprising:

exposing the oxide layer (an insulating layer of oxide formed on the substrate, see fig. 19, 15D, 11 and col. 11, lines 52-55) to a silicon-containing silane gas to convert a surface termination of the oxide layer from a hydroxyl-terminated surface to a hydrogen-terminated surface,

exposing the oxide layer (insulating layer is oxide layer, see col. 7, lines 52-53) to the silicon-containing silane gas,

forming the ruthenium metal layer 4 (metal layer 4 can be Pd, Ru, ..., see col. 8, lines 10-17) to contact the oxide layer, col. 11, lines 56-62, and fig. 19B.

The difference between the reference(s) and the claims are as follows: Fujii et al. teaches exposing the oxide layer with silane to form a hydrophobic surface before forming a ruthenium layer but does not teach that replacing the O-H bond of the oxide surface with hydrogen of silane (SiH_4) to become a hydrophobic surface. However, Terbrueggen et al. teaches at para. 172, the hydrophobic oxide surface is due to the replacement of O-H bond of oxide layer with silane gas. Yoshida et al. teaches at para. 37, silane gas (SiH_4) attached with silane coupling agent to form a methylated silane. And, the specific waiting time before depositing the ruthenium layer as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.

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It would have been obvious to one having ordinary skill in the art at the time the invention was made to have recognized that hydrophobic oxide surface is due to the replacement of O-H bond in the oxide layer with silane gas (Si-H, SiH₄) as suggested by Terbrueggen et al. and using a specific waiting time before forming a ruthenium layer on the exposed oxide surface so that hydrogen containing silane gas has sufficient to react with the oxide surface. And, silane gas (SiH₄) attached with silane coupling agent forms a methylated silane as taught by Yoshida et al. because silane coupling agent is used to replace a hydrogen atom from silane gas.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sashida et al. 2001/0012659 in view of Terbrueggen et al. 2004/0053290.

The reference(s) teach the features :

Sashida et al. discloses a method of adhering a ruthenium metal layer to an oxide layer of a semiconductor, the method comprising:

exposing the oxide layer 6 to a silane comprising essentially of silane, para. 72, and fig. 5B,

after exposing the oxide layer 6 to the silicon containing gas,

forming the ruthenium metal layer 17 to contact the oxide layer 6, para. 58.

The difference between the reference(s) and the claims are as follows: Sashida et al. teaches exposing the oxide layer with silane before forming a ruthenium layer but does not teach that replacing the O-H bond of the oxide surface with hydrogen of silane (SiH₄) to become a hydrophobic surface. However, Terbrueggen et al. teaches at para.

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172, the hydrophobic oxide surface (hydroxyl-terminated) is due to the replacement of O-H bond of oxide layer with silane gas. And, the specific waiting time before depositing the ruthenium layer as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have recognized that hydrophobic oxide surface (hydroxyl-terminated) is due to the replacement of O-H bond in the oxide layer with silane gas (Si-H, SiH₄) as suggested by Terbrueggen et al. and using a specific waiting time before forming a ruthenium layer on the exposed oxide surface so that hydrogen containing silane gas has sufficient to react with the oxide surface.

Claim 2-3 are rejected under 35 U.S.C 103 as being unpatentable over Sashida et al. as applied to claims 1, 4-6 above, and further in view of Skill level of one of ordinary skill in the art.

The difference between the references applied above and the instant claim(s) is: Sashida et al. teaches exposing the oxide layer to silane gas but does not teach the waiting time before the deposition of ruthenium layer. However, the specific waiting

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time before depositing the ruthenium layer as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the above references' teachings by waiting a specific time before depositing the ruthenium layer after exposing the dielectric layer to the silane gas because using a specific the waiting time is within the skill level of one of ordinary skill in the art so that that there is sufficient time for silane to react with the oxide layer.

Claims 7, 9-16, 18-20, 22-24, 26-35 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kuo iwa et al. 6,187,622 in view of Sashida et al. 2001/0012659.

The reference(s) teach the features :

Kuo iwa et al. discloses a method of forming a ruthenium layer to an oxide layer of a semiconductor, the method comprising:

Placing the wafer in the CVD process chamber, col. 8, lines 30-67,

Flowing SiH_4 silane gas into the chamber,

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exposing an insulating layer 110 formed on the substrate to the silicon-containing silane gas

flowing a ruthenium metal precursor into the chamber to form ruthenium metal layer 114 (metal layer 114 is a CVD process with Ru) on the insulating layer, col. 8, lines 66-67, col. 11, lines 58-63,

ruthenium metal precursor is bis(cyclopentadienyl) ruthenium, or a derivative of ruthenocene, col. 11, lines 58-63,

forming a storage capacitor 114/115/116, fig. 6,

forming a planarized dielectric layer, 110, fig. 1,

etching the dielectric layer 110 to expose the contact pad 106b.

The difference between the reference(s) and the claims are as follows: Kuroiwa et al. teaches exposing the inter-layer insulating film to silane (SiH_4) gas but does not teach inter-layer insulating film is an oxide layer. However, Sashida et al. teaches at para. 34, the inter-layer insulating film 4 is an oxide layer. Sashida et al. also teaches at 72 and 57, exposing the metal oxide to silane gas then forming a ruthenium upper electrode layer. And, the specific waiting time before depositing the ruthenium layer, gas flowing time and rate, depositing temperature and time as claimed are taken to be obvious since these are variables of art recognized importance which are subject to routine experimentation and optimization and discovery of an optimum value for a known process is obvious. In re Aller, 105 USPQ 233 (CCPA 1955). And, even if applicants' modification results in great improvement and utility over the prior art, it may

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still not be patentable if the modification was within the capabilities of one skilled in the art, In Re Sola 25 USPQ 433.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified Kuoiwa et al.'s inter-layer insulating film to oxide layer as suggested by Sashida et al. because using oxide material as inter-layer insulating film is well known in the art to form a thicker film on the semiconductor substrate. And, using a specific the waiting time,, gas flowing time and rate and deposition temperature and time are within the skill level of one of ordinary skill in the art so that that there is sufficient time and quantity of silane to react with the oxide layer.

Allowable subject matter

Claims 17, 21 and 25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims and overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph.

Conclusions

Applicant's arguments filed Nov. 16, 2006 have been fully considered but they are not persuasive. Applicant contends that para. 6 of instant invention discloses

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reasons of why the formation of an additional layer is to be avoided. However, para. 6 does not teach "exposure of the oxide layer to the silicon containing gas does not result in the formation of another layer over the oxide layer". And, para. 6 is also a prior art too. Sashida et al. clearly teaches at para. 72, exposing layer 6 to a compound comprising essentially of silane gas (SiH_4) during the formation of a layer 15. The thickness of layer 6 is not increased during the formation of layer 15. Since, claimed invention of "without substantially prior exposure of the oxide layer to oxygen" leaves oxide exposing to oxygen, hence, claim 1 is anticipated by Sashida et al. The Court of Appeals for the Federal Circuit ("CAFC") defined "substantially" as having its ordinary meaning of **"largely but not wholly that which is specified."** Ecolab, Inc. v. Envirochem, Inc., 264 F.3d 1358, 60 USPQ2d (BNA) 1173 (Fed. Cir. 2001). The CAFC has also held that the word "substantially" gives some definitional leeway. Seattle Box Co. v. Indus. Crating & Packing, Inc., 731 F.2d 818, 829 (Fed. Cir. 1984). The word avoids undue limits to the words that "substantially" modifies. C.E. Equip. Co. v. United States, 13 USPQ2d (BNA) 1365, 1369 (N.D. Tex. 1990); In re Hauserman, Inc., 5 USPQ2d (BNA) 1157, 1158 (1989). Such usage of "substantially" in claims also appears, for example, in several of the patents of record in the present application (e.g., Zuo, Ommen, Lischner, & Takano).

Fujii clearly teaches at col. 11, lines 52-54, exposing to a compound comprising essentially of silane gas attached (SiH_4) with silane coupling agent without exposing to oxygen and without increasing the thickness of oxide layer. Yoshida et al. teaches at para. 37, silane gas (SiH_4) attached with silane coupling agent to form a methylated

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silane. Terbrueggen et al. clearly teaches at para. 172, treating the oxide surface with silane gas.

Kuroiwa clearly teaches forming a lower electrode 114 on treated oxide layer 110. There is not seen that ruthenium metal layer is required to contact the oxide layer in claim 7. Kuroiwa also clearly teaches at 8, lines 34-42, oxide layer 110 is exposed to SiH_4 while filling the contact hole.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to H. Jey Tsai whose telephone number is (571) 272-1684. The examiner can normally be reached on from 7:00 Am to 4:00 Pm., Monday thru Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt can be reached on (571) 272-1873.

The fax phone number for this Group is 571-273-8300.

hjt

1/22/2007



H. Jey Tsai
Primary Examiner
Patent Examining Group 2800